

REMARKS/ARGUMENTS:

No claims have been added, canceled, or amended.

Claims 1 – 60 are in the case.

No new matter has been added.

Rejection of claims 53, 54, 58 and 59 under 35 USC §102(b) as anticipated by U.S. Patent No. 6,030,535 to Hayashi *et al.*

It is respectfully requested that the rejection of claims 53, 54, 58 and 59 under 35 USC §102(b) as anticipated by U.S. Patent No. 6,030,535 to Hayashi *et al.* be reconsidered for the reasons discussed below and be withdrawn.

Each of these rejected claims requires the use of an electrodialysis unit that is designed to operate at elevated pressure. The Office has argued that the '535 patent discloses treatment of retentate from the RO membrane at the retentate pressure, which should be a little reduced in comparison to the feed pressure 0.56 kgf/cm² disclosed at col. 12, lines 15 – 21 of the '535 patent.

With respect, the Applicant maintains that the '535 patent provides no teaching at all about the pressure of operation for the ED unit. At the location cited in the Action, Hayashi *et al.* is describing “[t]he operating pressure of the reverse osmosis membrane module ...” (col. 12, lines 10, 11), and “... the operating pressure of the reverse osmosis membrane module 2 ... is taken as 56 kg/cm².” (col. 12, lines 16 – 19). There is no mention of the operating pressure of the ED unit.

Furthermore, as Dr. Davis has pointed out in his Declaration in the first full paragraph of page 3, the only pump shown by Hayashi *et al.* is in Fig. 3, and a skilled practitioner would not have expected that this single pump would generate sufficient pressure to carry through the entire system, including the pretreatment, RO and then into a high-pressure ED unit. Rather, in the absence of guidance to the contrary, it would be expected that each unit would be operated at a pressure that would be normal and typical for that type of unit. At the location cited by the Office, the '535 patent is discussing the pressure that would be normal and expected for the RO unit. There is no teaching, express or implied, of the pressure of operation of the ED unit.

Accordingly, it is maintained that the Hayashi *et al.* patent cannot teach or suggest the subject matter claimed in the rejected claims and it is respectfully requested that the present grounds of rejection be reconsidered and be withdrawn.

Rejection of claims 1 – 9, 24 – 33, 37 – 42 and 55 – 57 under 35 USC §103(a) as obvious over U.S. Patent No. 6,030,535 to Hayashi *et al.*, in view of U.S. Patent No. 4,036,749 to Anderson

It is respectfully requested that the rejection of claims 1 – 9, 24 – 33, 37 – 42 and 55 – 57 under 35 USC §103(a) as obvious over U.S. Patent No. 6,030,535 to Hayashi *et al.*, in view of U.S. Patent No. 4,036,749 to Anderson, be reconsidered for the reasons discussed below and be withdrawn.

In brief, claims 1 – 9 describe a method comprising RO combined with ED having both univalent anion selective and univalent cation selective membranes, and a salt recovery unit. Claims 24 – 33 describe a method comprising RO combined with elevated pressure ED, and a salt-recovery unit. Claims 26 – 30 add univalent anion selective membranes and univalent cation selective membranes to the ED unit of the method described in the base claims.

Also in brief, claims 37 – 42 describe an apparatus comprising a pump, and a combination of an RO unit and an ED unit having univalent anion selective membranes and univalent cation selective membranes, and also including a salt recovery unit. Claims 55 – 57 describe the apparatus of base claims 53 and 54 (that require a pump, RO, elevated pressure ED, and salt recovery unit), and add the requirement that the ED unit has univalent anion selective membranes and univalent cation selective membranes.

The Office has argued that Hayashi *et al.* teach the method and apparatus combining RO, ED and evaporation, but fail to disclose an ED unit with a plurality of ED membranes. The Office then argues that it would have been obvious to use the cationic and anionic membranes as disclosed in the '749 patent with the motivation being to produce different salts from the process as suggested by '749.

With respect, the Applicant maintains that this argument fails to establish a *prima facie* case for obviousness under 35 USC §103(a) for several reasons. First, no

reference, or combination thereof, teaches that the ED unit must have both univalent anion selective membranes and univalent cation selective membranes as required in each of claims 1 – 9, 26 – 30, 37 – 42, and 55 – 57. In fact, the Anderson patent merely teaches that an electrodialysis unit can have “...alternate membranes which are permeable to cations or anions, respectively.” This falls short of a teaching of the present ED unit having both univalent anion selective membranes and univalent cation selective membranes.

Moreover, as Dr. Davis has discussed at the top of page 4 of his Declaration, the Anderson ‘749 patent does not teach the use of a combination of RO and ED, as the Office has argued, and as is required in each of the rejected claims. Rather, the ‘749 patent teaches a pre-treatment method that it states can be combined with “... any of a plurality of [brine formation] processes.” (col. 5, lines 7, 8). The ‘749 patent then proceeds to list and discuss what types of processes could serve as a brine formation process. But it never teaches or suggests the combination of RO and ED, as is required in the present process.

It should also be recognized that Hayashi *et al.* is silent as to the use of both univalent anion and univalent cation selective membranes as is required in certain of the presently rejected claims. At col. 5, lines 32 – 35, the Hayashi *et al.* patent states that it is preferred that its ED unit includes an ion exchange membrane having selectivity “... for preventing the permeation of predetermined divalent anion[s]”, and at col. 6, lines 62 – 64 of the Hayashi *et al.* specification, the only ion-selective ED membranes that are identified are the commonly used univalent anion selective membranes that reject sulfate (SO_4^{2-}). No univalent cation selective membranes, as required in the presently rejected claims 1 – 9, 37 – 42 and 55 - 57 are disclosed at all. Furthermore, as Dr. Davis has discussed in his Declaration on page 2, in the section on the Hayashi *et al.* patent, the skilled practitioner would not have been motivated to use a univalent cation selective membrane in the Hayashi *et al.* method or apparatus, because the objective of Hayashi *et al.* was different than the objective of the present application. Whereas Hayashi *et al.* wished to obtain sea salt, the present invention obtains purified sodium chloride – having much reduced levels of calcium, magnesium, sulfates, carbonates, bromide, and other ions that are present in sea water. One way in

which the present invention accomplishes this is by the combination of univalent anion selective membranes and univalent cation selective membranes. As Dr. Davis has discussed at paragraph [00062] of the present specification, an “anion selective membrane” is not necessarily a “univalent anion selective membrane”, as required in some embodiments of the present invention, nor is a “cation selective membrane” necessarily a “univalent cation selective membrane”.

As to the specific comments in the Action concerning claim 3, the Applicant with respect cannot find that the Anderson patent discusses anything close to the requirements that the membranes can be univalent-ion-selective, *e.g.*, rejecting magnesium or calcium, at the locations cited in the Action (namely, col. 7, lines 49 – 68 and col. 8, lines 1 – 7). At these locations, Anderson appears to be discussing the use of carbonation with carbon dioxide gas.

Further comments in the Action regarding dependent claims are addressed by Dr. Davis on pages 4 and 5 of his Declaration.

It is maintained, therefore, that without a teaching of the use of either high pressure operation of the ED unit, or the use of an ED unit having both univalent anion selective membranes and univalent cation selective membranes, as required in the presently rejected claims, neither the Hayashi *et al.* or the Anderson patents, or any combination thereof, can make obvious the present claims. It is respectfully requested, therefore, that the present ground of rejection be reconsidered and be withdrawn.

Rejection of claims 10 – 23, 34 – 36, 43 – 52, 55 and 60 under 35 USC §103(a) as obvious over U.S. Patent No. 6,030,535 to Hayashi *et al.*, in view of U.S. Patent No. 4,036,749 to Anderson, and further in view of U.S. Patent No. 5,458,781 to Lin.

It is respectfully requested that the rejection of claims 10 – 23, 34 – 36, 43 – 52, 55 and 60 under 35 USC §103(a) as obvious over U.S. Patent No. 6,030,535 to Hayashi *et al.*, in view of U.S. Patent No. 4,036,749 to Anderson, and further in view of U.S. Patent No. 5,458,781 to Lin, be reconsidered for the reasons discussed below and be withdrawn.

In brief, claims 10 – 23 describe a method comprising the production of purified water and salt by using a combination of an RO unit with ED, where ED diluate passes

to a nanofiltration (NF) unit, and where the ED concentrate passes to salt recovery and the NF permeate is recycled to the RO. Claim 34 adds passing the NF retentate to magnesium recovery. Claims 36 adds that the ED unit is operated at elevated pressure.

Also in brief, claims 43 – 52 describe an apparatus comprising a pump and a combination of an RO unit with ED, salt recovery and NF, in which certain streams are directed to certain pieces of equipment. Claim 55 (which depends on claims 53 and 54), adds the requirement that the ED unit has both univalent anion selective membranes and univalent cation selective membranes. And claim 60 (dependent upon claim 53) adds the presence of a nanofiltration unit.

In the recent Action, the Office has argued that Lin teaches treating a concentrated salt stream from an RO by nanofiltration to separate monovalent ions from divalent ions and permeate monovalent ions, including bromide.

In each of the presently rejected claims, it is required that the retentate from an RO unit is fed to an ED unit, and that the diluate from the ED unit is then passed to a nanofiltration (NF) unit. Lin fails to mention the use of ED at all. The Office argues that it would have been obvious for the skilled practitioner to remove or separate monovalent ions from divalent ions using a NF unit as taught by Lin, “therefore further combining the system of `535, or the system of `535 with `749 ...”. With respect, this reasoning fails to state a *prima facie* case of obviousness under 35 USC §103(a). One reason for this is that there is no motivation to place an ED unit between the RO and the NF units of Lin. Such an act may have been obvious to try, but the motivation falls short of the expectation for success that is required by 35 USC §103(a). In fact, because the purpose of Hayashi *et al.* was to produce sea salt, the inclusion of an NF unit that separated monovalent and divalent salts would destroy the purpose of Hayashi *et al.*’s method and apparatus. Such a combination, therefore, would actually be recognized by the skilled practitioner to be undesirable.

It is respectfully requested, therefore, that the present ground of rejection be reconsidered and be withdrawn.

Other art references cited but not depended upon:

In U.S. Patent No. 4,083,781 to Conger, a desalination system is described that consists essentially of a reverse osmosis system, an evaporation unit, a brine concentration unit (of a conventional type such as a vapor compression evaporative system), concentration ponds, means for electrolyzing brine and water splitting means. This patent provides no guidance for combining the system that is described with an electrodialysis unit or a nanofiltration unit, as are used in some embodiments of the present invention, or for operation of the ED at high pressure, or for using a combination of univalent anion selective membranes and univalent cation selective membranes, as required in other embodiments of the present invention. Moreover, the purpose of the unit is to produce pure water and products derived from the salt content of the water, rather than to produce a purified sodium chloride, as is one objective of the present invention.

U. S. Patent No. 5,928,853 to Yamamoto relates to a method of manufacturing silver halide emulsion by ultrafiltering and electrodialyzing a silver halide emulsion in order to desalt and concentrate the emulsion. Other than utilizing electrodialysis and ultrafiltration in conjunction with a salt-containing liquid, this patent shares little in the way of apparatus or process with the present invention.

U.S. Patent No. 6,814,865 to Aminabhavi *et al.* describes ion exchange membranes and their production and use in the electrodialysis of brackish water or seawater. The patent lacks the disclosure of most of the other elements that are features of the present claims.

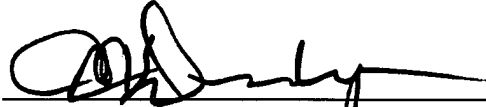
It is maintained, therefore, that none of the three patents that were cited but not depended upon in the Action, either alone or in combination with each other or with any of the patents that were cited in the rejections, teach or suggest the invention that is described in the present claims.

Request for reconsideration:

It is respectfully requested that the claims be reexamined in view of the reasons discussed above and found to be allowable. If it would be helpful, the Examiner is invited to contact the undersigned attorney at the telephone number provided below.

Respectfully submitted,

Date: January 10, 2006

A handwritten signature in black ink, appearing to read 'C. E. Dunlap', written over a horizontal line.

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